relatively to each other during the time elapſed between their paſſage to the ſame thread.

Obſervation de l'eclipſe de Lune.

ON a fait uſage dans cette obſervation de la même quart de cercle, et de la même lunette qui avoient ſervi pour l'obſervation de l'eclipſe de ſoleil. La marche de la pendule etoit cependant un peu differente parce qu'on y avoit touché.

N° XXXII.

An Account of the Tranſit of Venus over the Sun, June 3d, 1769, as obſerved at Newbury, in Maſſachuſetts; by the Rev. SAMUEL WILLIAMS, A. M.

THE tranſit of Venus over the ſun, being one of the moſt uncommon and uſeful phenomena in aſtronomy, I determined to make as careful an obſervation of it as I could. Early in May I received an invitation from *Triſtram Dalton*, Eſq. a gentleman of Newbury-Port, to obſerve it with him. He had a ſeat at Newbury, in a high elevated ſituation, very convenient for this purpoſe, at which we agreed to make the obſervation. The weather for ſeveral days had been dull and rainy, but clearing up on Tueſday evening I went early on Wedneſday to put every thing in readineſs. The regulation of our clock being an article of great importance, I was very careful to have it thoroughly examined, and well fitted up. To adjuſt it to apparent time we took correſponding altitudes of the ſun, both before and on the day of the tranſit. In theſe obſervations, it was eaſy to arrive to a pretty great exactneſs; and as they were very numerous, the going of the clock was well aſcertained by them, and found to be ſteady and regular. The teleſcope we had prepared was a reflector made by *Nairne*, magnifying about 55 times; a good inſtrument, but not fitted with a micrometer,

micrometer, or with vertical and horizontal hairs, as we could have wiſhed.

The third of June proved favourable to our wiſhes. The air was uncommonly clear, and the ſky ſerene. About twenty minutes before the tranſit, I began to keep my eye ſteadily fixed on that part of the ſun's limb, on which the planet by calculation was to enter; an aſſiſtant counting the clock in the mean time, while another ſtood by to write down the obſervations. Thus prepared, we waited with a kind of agreeable anxiety for the high ſatisfaction of ſeeing Venus on the ſun; a ſatisfaction I had once before enjoyed in viewing the tranſit of 1761*, and which I knew muſt end with that of 1769! The firſt impreſſion of Venus on the ſun, I expected would not appear like a diſtinct well defined black ſpot coming on as it were in an inſtant, but rather like an ill defined mixture of limbs. The event was agreeable to the conjecture, for at 2^h 30′ 14″, apparent time, I imagined I ſaw *a ſmall diſturbance* on the ſun's limb; but the impreſſion was then ſo ſmall, irregular and ill defined, that it was not till after ſeveral ſeconds that I was certain the tranſit was begun. But the impreſſion increaſing and growing more diſtinct, I fixed on the time mentioned above as the time of the *external contact*. To obſervers with teleſcopes and eyes equally good, and fixed on that part of the ſun on which the planet entered, I conceive this firſt impreſſion might have been obſerved to an agreement of 5 or 6 ſeconds. Though perhaps it might be the contact of the atmoſphere, rather than of the body of Venus with the ſun.

In about ten minutes after the *external*, I began to look for the *internal contact*. From the form in which Venus appeared, being ſurrounded with a glimmering light, not very diſtinctly defined, I concluded it would be difficult if not impoſſible to fix upon the preciſe moment when her

* At St. *John*'s, in *Newfoundland*.

limb would be exactly coincident with that of the ſun; and therefore determined to wait till there ſhould appear a ſmall thread of light between them. As the contact drew near, the thread of light began to form, and ſeemed to dart on each ſide of the planet for ſeveral ſeconds without being fixed or ſettled. At $2^h\ 48'\ 44''$, with a ſeeming uncertainty of not more than $7''$ it became cloſed and fixed; Venus then appeared wholly within the ſun, ſeparated from its limb by a fine ſtream of light flowing gently round it. This I fixed upon as the *internal contact*, though this might alſo be the contact not of Venus but of her atmoſphere with the ſun. Not having a *micrometer* or *hairs* fixed in the reflector, inſtead of making any further obſervations, we could only enjoy the pleaſure of viewing this curious phenomenon, and ſhowing it to a number of gentlemen that had aſſembled on the occaſion.

To determine the latitude of the place, we took the meridian altitude of the ſun on the day of the tranſit, by tranſmitting his rays from a ſtyle 10 feet high, upon a large horizontal platform. From this obſervation our latitude came out $43°\ 2'$ north. Suſpecting the obſervation was not ſufficiently accurate, I have ſince carefully examined the matter, and from ſeveral obſervations which nearly agree, I find it to be but $42°\ 57'$ With regard to our longitude, the mean of ſix or ſeven obſervations of the eclipſes of Jupiter's firſt ſatellite, gives it about $4^h\ 42'\ 30''$ weſt from *Greenwich*.

In the above account of the *contacts*, the duration of the ingreſs, or paſſage of Venus over the ſun's limb, is $18'\ 30''$; near a minute longer than in moſt of the *American* obſervations. By theory it ſhould be $18\ 56''$, but as this muſt have been contracted at the place of obſervation, $15''$, by parallax, the apparent duration of the ingreſs, would be but $18'\ 41''$; that is, $11''$ longer than it was made by obſervation. I much doubt whether it was poſſible to diſcern the planet ſo ſoon as $11''$ after the firſt

firſt contact, when not a ſecond of its diameter had entered upon the ſun. It is moſt probable that the *internal contact* was paſt before the thread of light appeared to me to be compleated. It ſeems as though ſomething of the ſame kind, muſt alſo have been the caſe in moſt of the *European* obſervations; as they make the ingreſs near a minute longer, than it was ſeen by moſt of the *American* obſervers, when by theory it muſt rather have been ſhorter. But the different appearances of Venus, different ideas of the contacts, with the unavoidable difference of eyes, teleſcopes, the ſtate of the atmoſphere and the like, might eaſily occaſion ſuch differences in the obſervations. Though in the ſame circumſtances, it can hardly be thought but that the *European* and the *American* obſervations would have more nearly agreed.

An Account of the Tranſit of Mercury over the Sun, November 9th, 1769, as obſerved at Salem, in Maſſachuſetts; by the Rev. SAMUEL WILLIAMS, A. M.

THE tranſits of Mercury, though they are not of equal uſe in aſtronomy with thoſe of Venus, are yet of great advantage to perfect the elements of his theory, and to determine the longitude of places on the earth. I had an opportunity to obſerve one of theſe tranſits, November 9, 1769, in company with *Andrew Oliver*, Eſq. at *Salem*. Mr. Oliver had a good reflector, magnifying about ſixty times. But his clock not being in ſo good order as was to be wiſhed, and not having any inſtrument to take altitudes, I was obliged to have recourſe to the following method to determine the time. The day before the tranſit I drew a meridian line, with which I examined the going of the town clock on the day of the tranſit, and on the day after, and found it had kept time very well. Comparing my watch with the clock, the time was pointed out to minutes pretty exactly. Taking the minutes from

from the watch, I endeavoured to count the ſeconds, which by a perſon uſed to it may be done pretty near the truth. This method of determining the time, though ſuch as an aſtronomer would by no means chuſe, was the only one that I could make uſe of; and from the pains I took to be exact, I believe it might be depended upon to eight or ten ſeconds.

At the *firſt contact* I expected *Mercury* would have appeared as Venus had done, ſomething irregular, uneven, and not very diſtinctly defined. But at 2^h 54′ 40″ apparent time, I was agreeably diſappointed by ſeeing the planet come on as it were in an inſtant, in the form of a clear, regular, well defined black ſpot. The *internal contact* was equally inſtantaneous; at 2^h 56′ 0″ the thread of light cloſed to appearance in a moment, without a ſeeming uncertainty of a ſecond. The ſky being perfectly clear and ſerene, nothing could be better defined than the limbs of Mercury and the ſun. There was no appearance of any thing like an atmoſphere round the planet, but all the time the ſun was viſible, Mercury appeared like a ſteady diſtinct black ſpot, much leſs than ſome that were then upon the ſun. Not having a micrometer, it was not in our power to make any further obſervations, either on the diameter of the ſun or Mercury, or of the leaſt diſtance of their limbs.

An Obſervation of an Eclipſe of the Sun, November 6th, 1771, at Bradford, in Maſſachuſetts; by the Rev. SAMUEL WILLIAMS, A. M.

FROM the beginning of the year 1769 till the end of 1771, there were but two eclipſes that could be obſerved at *Bradford*. One of theſe was a total eclipſe of the moon, June 19th, 1769; of this I had no obſervation, being prevented by an indiſpoſition. The other was an eclipſe of the ſun, November 6th, 1771. The weather for ſeveral

ral days before, was ſo cloudy that I attempted in vain to regulate my clock, though I watched every favourable opportunity. On the day of the eclipſe I got it pretty well adjuſted by ſeveral correſponding altitudes of the ſun. About 1^h P. M. the clouds gathered ſo much round the ſun, that I was apprehenſive they would prevent any obſervation. But being pretty much ſcattered, at $1^h\ 36'\ 42''$ apparent time, I could very plainly perceive that the eclipſe was juſt begun. This I judged was very near the beginning, if not exactly ſo, though it was attended with ſome uncertainty. In a few minutes the ſun was wholly covered with the clouds, and remained thus till $3\frac{1}{2}^h$, when they began again to ſcatter, and left that part of the heavens in which the ſun appeared, perfectly clear. The weather continued thus till the end of the eclipſe, which by a good obſervation was at $3^h\ 47'\ 2''$. Theſe obſervations were made with a reflector made by *Nairne*, magnifying as near as I could judge about ſixty times; but as to the *quantity* of the eclipſe, no obſervation could be made, the ſun being obſcured by the clouds the biggeſt part of the time.

N° XXXIII.

An eaſy and accurate Method of finding a true Meridian Line, and thence the Variation of the Compaſs.

By ROBERT PATTERSON.

Read Apr. 7, 1786.

OF the various methods which aſtronomers employ for finding a true meridian line, none ſeems ſo well adapted, as could be wiſhed, to the common uſe of ſurveyors, in finding the variation of the Compaſs.

To find the azimuth of the ſun by a ſingle obſervation of his altitude, beſides a quadrant which is neceſſary ſo thi